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AUTHORITY
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VARIAN ENGINEERING
REPORT NO. 132-11

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PROGRESS REPORT

REFINEMENT AND PRODUCTION OF 1000 RUGGED X-BAND LOCAL OSCILLATOR V-52 KLYSTRONS

For Period: 1 May to 31 May 1953

Prepared for

Bureau of Ships Navy Department

on

BuShips Contract NObs-5358

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JULY 1953

PURPOSE

The purpose of the program engaged under BuShips Contract NObs-5358 is to refine and produce one thousand (1000) rugged X-band local oscillator V-52 klystrons. This tube is to comply with the specifications of SHIPS E-720, which were subsequently modified at a conference held at the Bureau of Ordnance, Washington, D.C. on 20-21 May 1952 and later at a conference held at Varian Associates on 29-30 September 1952.

PROGRESS

Since the acceptance of the modified drift proposal (warm-up plus ambient drift not to exceed 10 mc), there has been a general deterioration of both warm-up drift and power output in production tubes. It was previously estimated, on the basis of probability plots, that a yield of approximately 25 - 30 per cent could be expected. However, this has not proven to be true. In fact, even excluding losses due to drift, a yield of only 12 per cent is being attained. Extensive investigation into the cause of this decline is currently under way. Production tubes are being carefully compared to prototype models by filling the tubes with a plastic material, sectioning, polishing surfaces, and making tracings from the screens of optical comparators. The only differences so far noted lie in the plating thickness[1] and the amount of brazing-alloy filler used between adjacent parts. Both of these are being corrected, pending availability of new parts. In general, production tubes appear more uniform and geometrically true than the prototypes (probably because of the improved brazing fixtures); but no correlation seems to exist between any eccentricities or misalignments and the various operational parameters.

Consideration was given to the possibility that pretuning by bowing the plate on which the third grid is mounted might be introducing stresses which later tend to be relieved while in operation. A number of tubes were assembled in which pretuning was followed by a "normalizing" heat treatment,

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1 Varian Engineering Report No. 132-10

followed by a cold frequency check and completion. No improvement could be noted in the tubes so handled.

Regarding the grid mounting difficulties previously reported, a process is being tried on a small number of tubes in which the entire drift tube assembly is accurately plated with silver prior to grid mounting. Subsequent firing with grids in position causes a silver-copper eutectic alloy to form, thus bonding the grids to the assembly. Productionwise, this operation is very satisfactory, but its use will depend upon test results since there is a possibility of increased cavity loss in the silver-copper alloy formed (which has conductivity lower than either component metal).

An investigation is being carried on to simplify and improve the mica window seal-in operation.

Several samples of tubes have been produced using r-f induction, and results have been very encouraging. It is believed that an automatic or semi-automatic operation could be attained by this method. Also, in the line of cost reduction, a swaged exhaust tube is being developed to replace the machined part presently in use.

Further changes have been found necessary in the potted ends of the tube in order to improve lead adherence and ability to withstand the humidity requirements of the V-52 specifications. The result was an increase in overall tube length, which had to be compensated in order that the maximum required dimensions would not be exceeded. The new type of reflector stem previously reported has been used in small lots of tubes with no apparent difficulty.

An effort has been made to transfer parts procurement to the production control department in order that engineering time can be more profitably utilized. This will not be entirely possible, however, since some parts are still very unsatisfactory from a production standpoint, having very poor yield or being quite difficult to handle. These parts will have to be redesigned, but not until the tube has been brought under control. Meanwhile, much engineering time will have to be devoted to direct or indirect procurement until the design is stabilized.

Thirty-eight tubes were pumped during the month, of which 31 reached test. Average test values obtained are given in Table I.

TABLE I

Frequency (mc)	8800.00	9600.00
Beam voltage (v)	350.00	350.00
Beam current (ma)	52.32	52.09
Reflector voltage (v)	-125.35	-162.96
Power output (mw)	82.80	99.20
Bandwidth (mc)	65.45	40.96
Modulation sensitivity (mc/v)	2.09	1.33
* Ten-minute drift (mc)	—	-9.00

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* Approximate peak of distribution (not arithmetic average)

At the end of May, tube No. 679 on life test had logged 1500 hours of operation. Tubes No. 653, 673, and 738, also being life tested,

have operated for approximately 800 hours. So far, no significant changes in tube characteristics have been noted.

During the month of May delivery was received from the Lindberg Engineering Company of the RMF-6246 A-96 C5 Rod Element, inconel muffle, hump mesh belt conveyor furnace together with all associated equipment. This furnace will be assembled, installed, and placed in operation as soon as possible.

Also received early in the month was the program controller for the silastic rubber curing oven. The delivery of this item made it possible to install the curing oven and place it in operation during the month.

In conjunction with the silastic molding program it was necessary to design and order a humidifying oven to prepare the silastic rubber material for the molding operation. This was made to our design by a local manufacturer and was placed in operation.

During May a silastic rubber rolling mill, Item No. 22 on the Facilities List, was designed and materials ordered.

Delivery was also made this month on the grid wire plating machine which was ordered several months previously. This machine will be placed in operation as soon as performance tests are completed.

PROGRAM FOR NEXT INTERVAL

The investigation into the general deterioration of both warm-up drift and power output of production tubes will continue.

A simplified and improved method of sealing in the mica window will continue under study.

Additional tubes will be tested. Test results will be followed closely to determine correlation, if any, between assembly changes and operational parameters. Particularly in this regard, the new method of grid mounting instituted this month will be checked against test results obtained.

Life testing of tubes will be continued.

Estimated expenditures during May 1953: $13,600.00

Estimated man-hours during May 1953: 1370

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